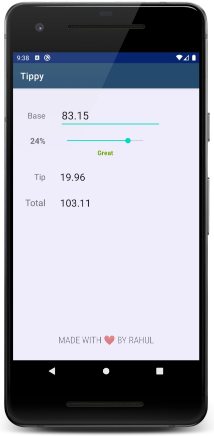
CS194A

Android Programming Workshop

Lecture 8: Nov 10, 2021
Rahul Pandey

Outline

- Logistics
- Remote Databases (Firebase)
- Fragments
- Android testing
- App architecture
- Alternatives to native app development



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Tippy

Base 83.15

24%

Great

Tip 19.96

Total 103.11

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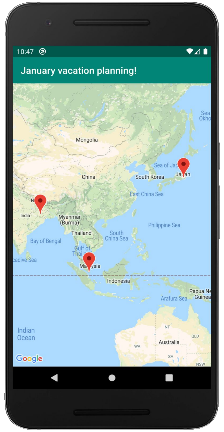

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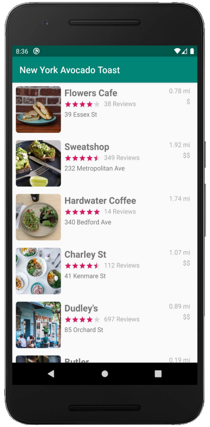
January vacation planning!



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New York Avocado Toast

Flowers Cafe ★★★★☆ 38 Reviews 39 Essex St	0.78 mi $
Sweatshop ★★★★½ 349 Reviews 232 Metropolitan Ave	1.92 mi $$
Hardwater Coffee ★★★★★ 14 Reviews 340 Bedford Ave	1.74 mi
Charley St ★★★★½ 112 Reviews 41 Kenmare St	1.07 mi $$
Dudley's ★★★★☆ 697 Reviews 85 Orchard St	0.89 mi $$
Butler	0.19 mi

Assn 1: Tip Calculator

Assn 2: Google Maps

Assn 3: Yelp Clone

Industry panel discussion

1 2 3 4 5 6 7 8 9 10

Week #

Code review- what to look for?

- Architecture review
- Tests
- Logic/functionality errors
- Complexity
- Comments
- Style

Try it out: sample pull request

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Remote Cloud Databases

- Where does the data for your app come from?
  - Local SQLite database
  - Web API
  - Your own backend service
- Remote cloud database: combines benefits of local storage using SQLite and Web APIs

Build your own backend

- Use a technology such as Django (Python), Ruby on Rails, Node (Javascript), etc. to create your own backend, hosted on a server
- Lots of headaches, and requires expertise in various domains:
  - Redundancy/robustness: database backups
  - Scaling: what happens when your app becomes popular?
  - Security: database passwords, key rotation, etc.

BaaS = Backend as a service

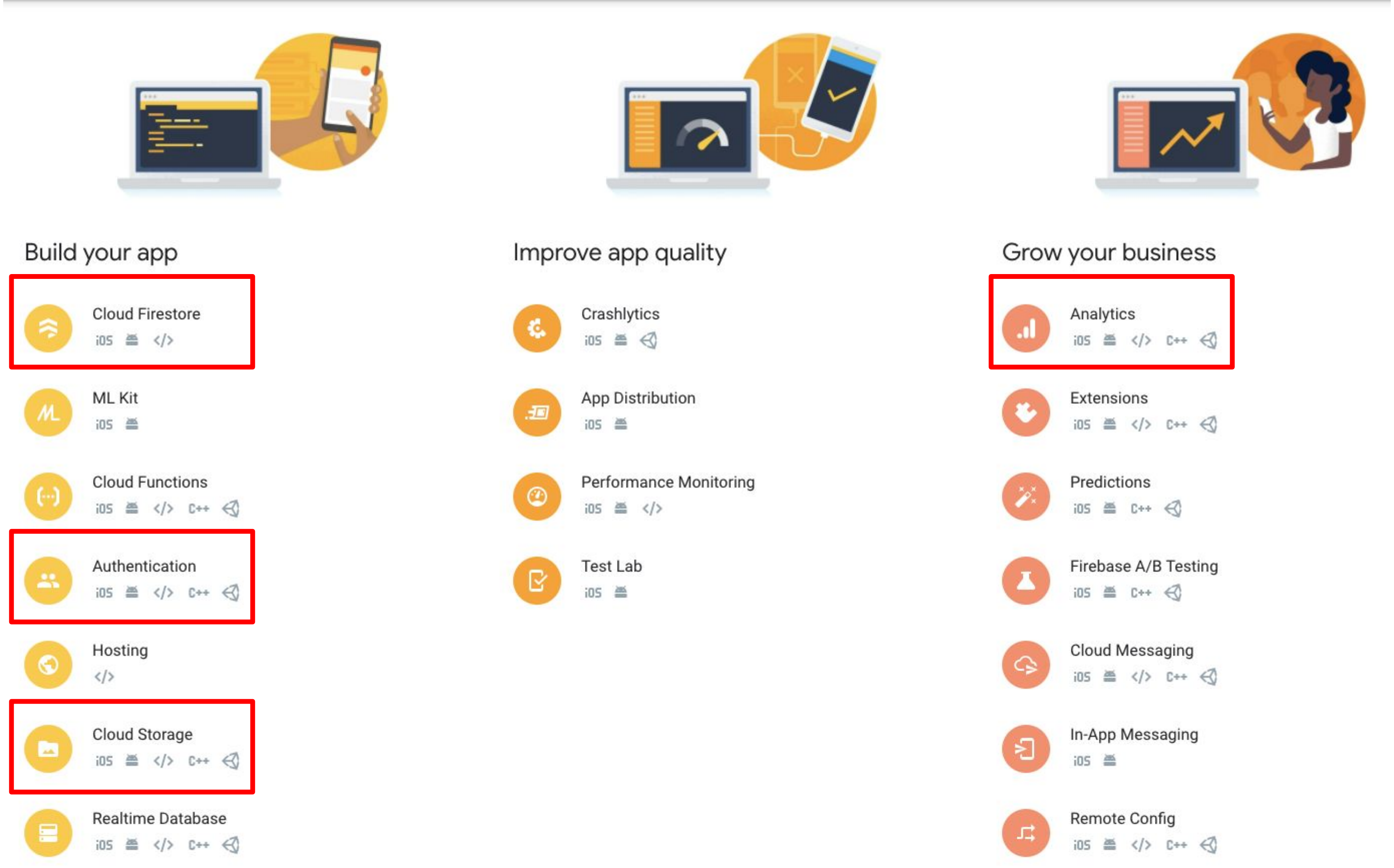
- Platforms for database/service hosting, management, deployment, etc.
- Free for most student/toy projects, you only get charged for usage beyond the free tier.
- Features:
  - Easy setup and integration with mobile apps
  - Web UI to view/modify data
  - APIs to perform CRUD operations on the data
  - As a developer, you must comply with the limitations around querying

NoSQL databases

- NoSQL databases: does not use SQL to access the data, there is no strict schema
    - **Benefits**: simplicity, flexibility, “horizontal” scalability to many servers
    - **Drawbacks**: some queries are more expensive, less structure around data may lead to data inconsistency, lack of “ACID”

Firebase

- Remote database management platform, owned by Google
    - Has become more popular since Facebook stopped managing Parse
    - Incorporates many services to develop your app, grow your user base, and monetize.
    - Popular among hobbyists and for early-stage startups



Build your app

Cloud Firestore
iOS </>

ML Kit
iOS

Cloud Functions
iOS </> C++

Authentication
iOS </> C++

Hosting
</>

Cloud Storage
iOS </> C++

Realtime Database
iOS </> C++

Improve app quality

Crashlytics
iOS

App Distribution
iOS

Performance Monitoring
iOS </>

Test Lab
iOS

Grow your business

Analytics
iOS </> C++

Extensions
iOS </> C++

Predictions
iOS C++

Firebase A/B Testing
iOS C++

Cloud Messaging
iOS </> C++

In-App Messaging
iOS

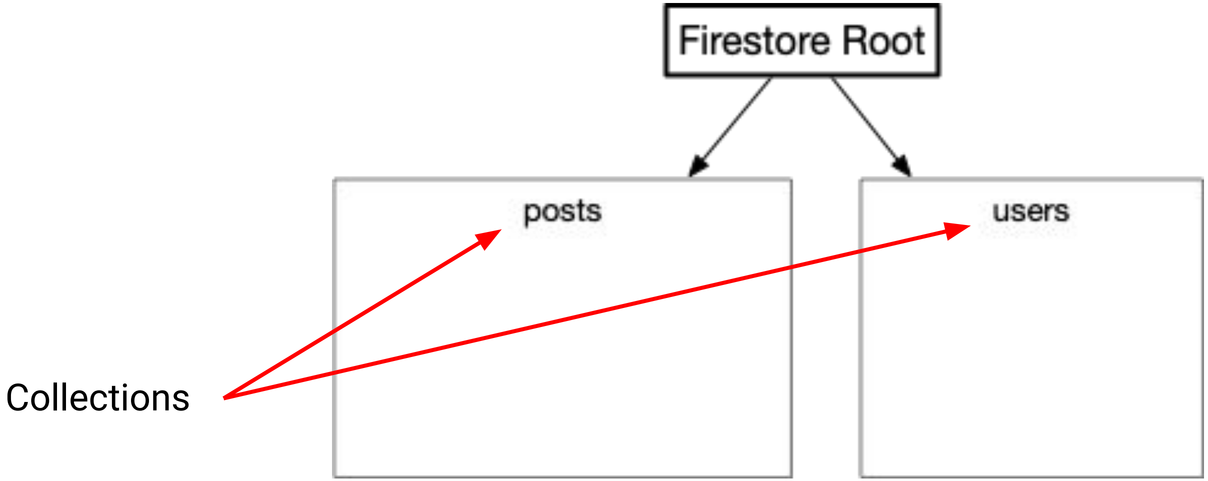
Remote Config
iOS </> C++

Firestore

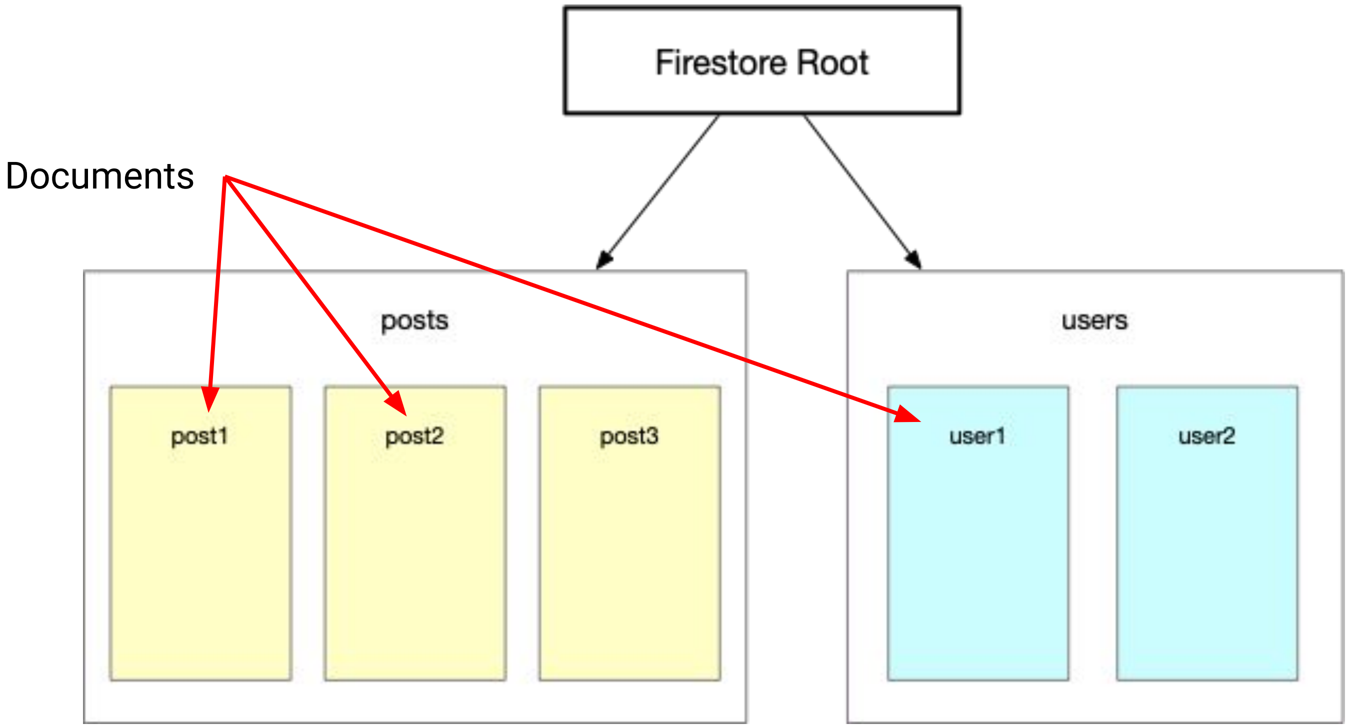
- “Flexible, scalable database for mobile, web, and server development”
- Keeps data in sync across clients through real time updates
- Automatic offline support

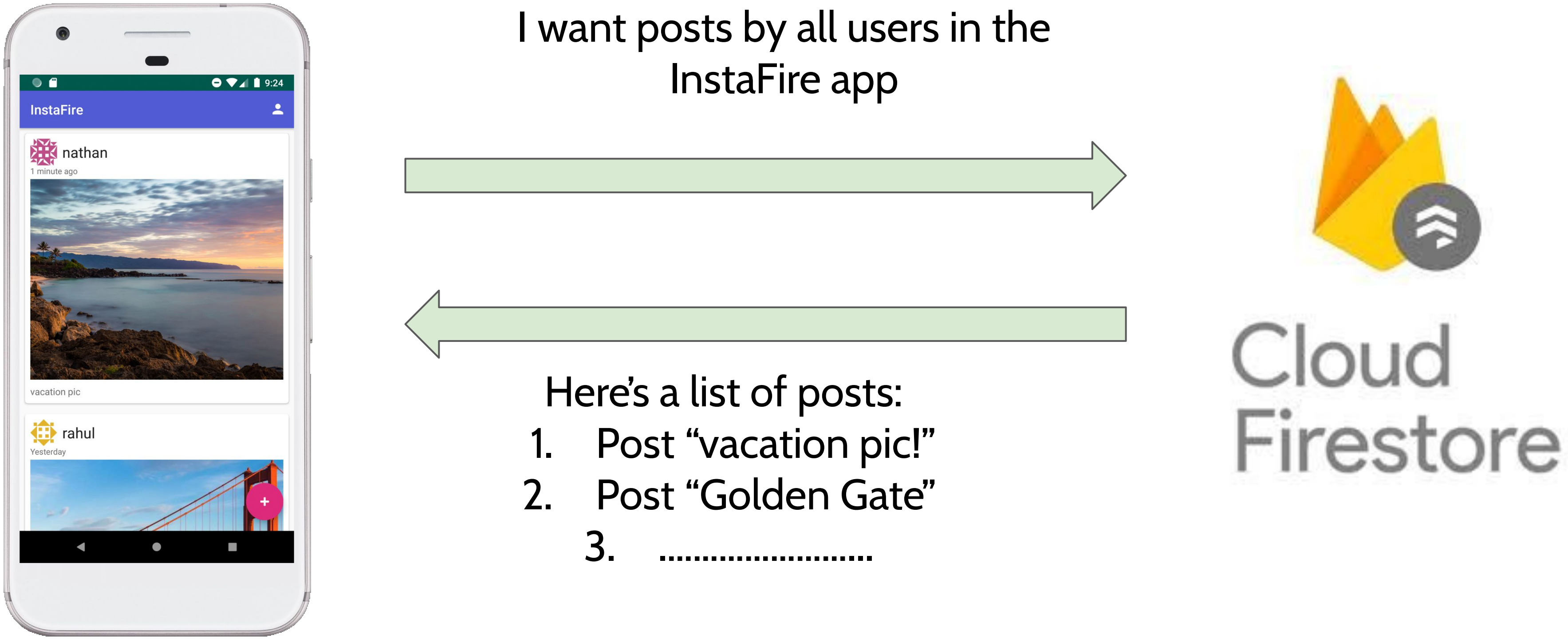
Firestore

- NoSQL cloud database to store and sync data
- Made up of documents and collections
  - Documents are like JSON objects which have fields of various types
  - Collections are a group of documents



- Documents define the attributes for that object



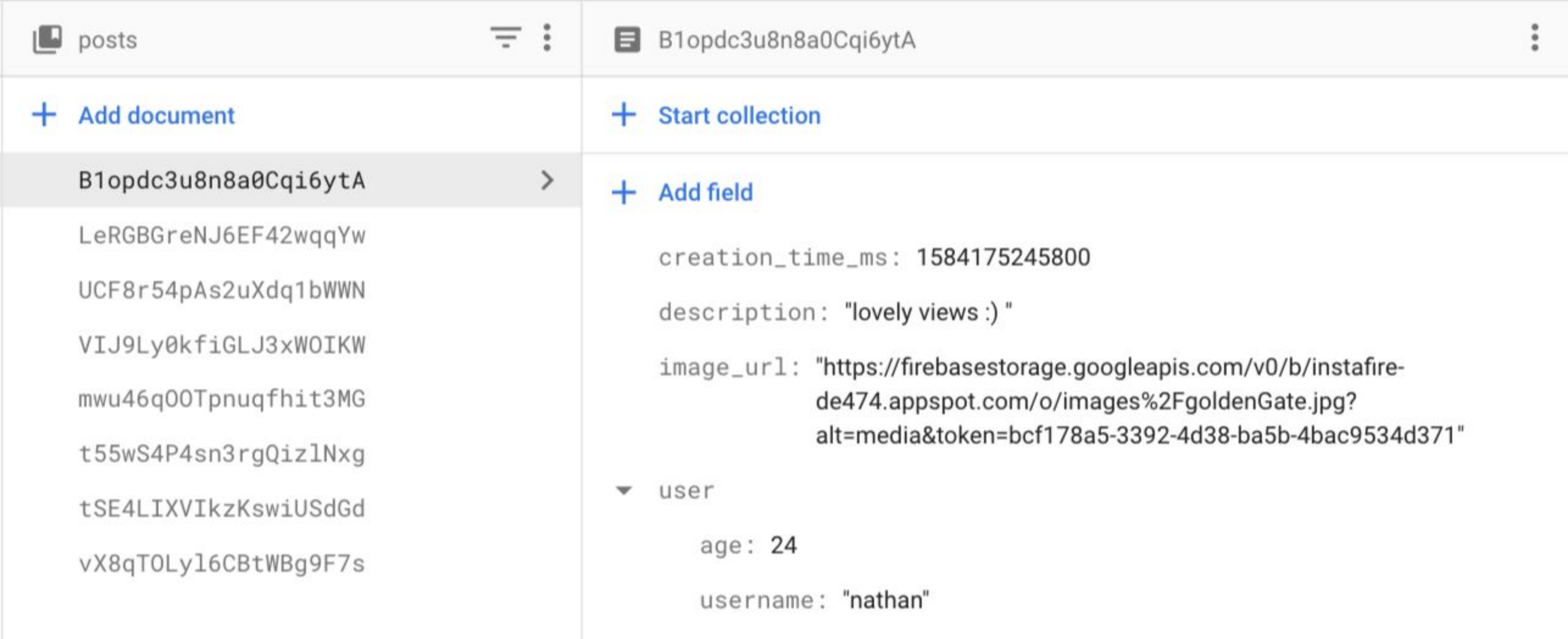


I want posts by all users in the InstaFire app

Here’s a list of posts:

1. Post “vacation pic!”
2. Post “Golden Gate”
3. ....

Cloud Firestore



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VIJ9Ly0kfiGLJ3xWOIKW
mwu46qOOTpnuqfhit3MG
t55wS4P4sn3rgQizlNxg
tSE4LIXVIkzKswiUSdGd
vX8qTOLyl6CBtWBg9F7s

creation_time_ms: 1584175245800

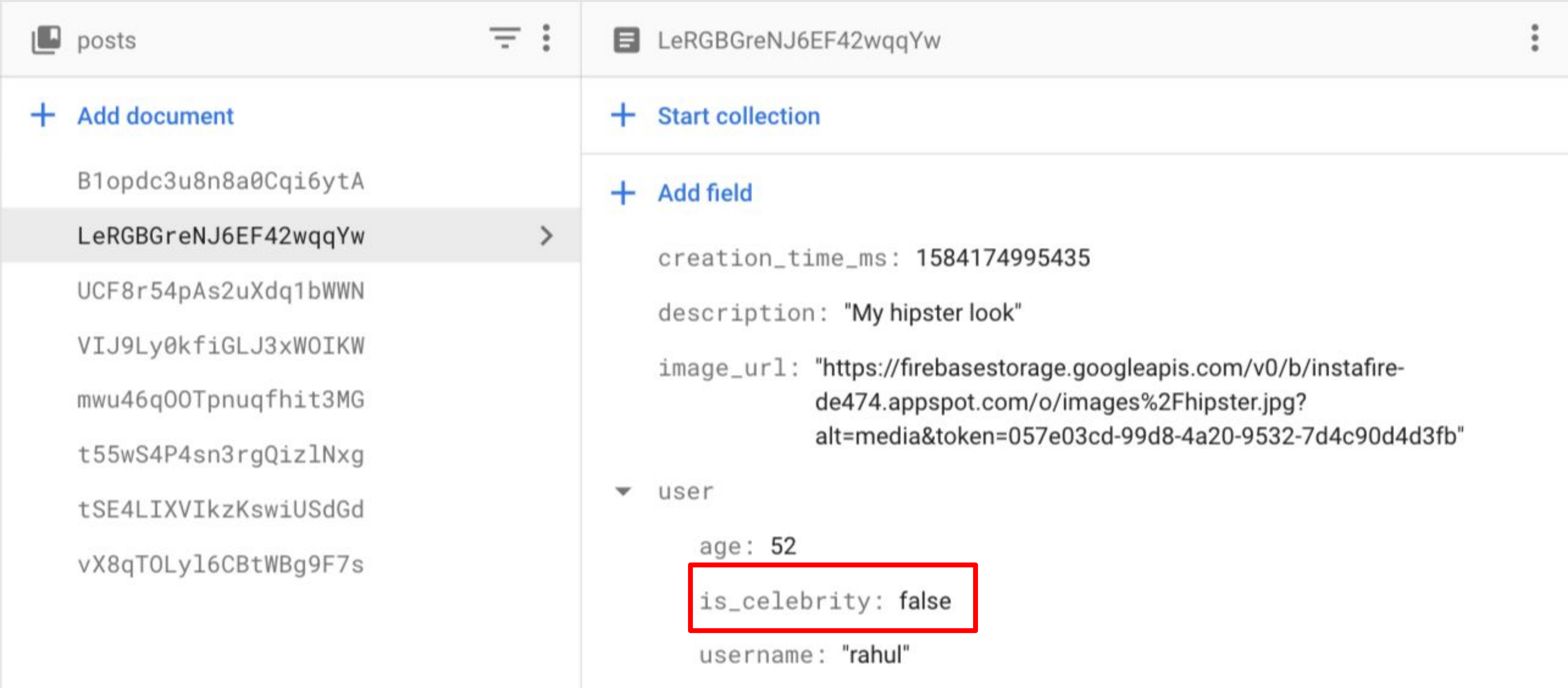
description: "lovely views :) "

image_url: "https://firebasestorage.googleapis.com/v0/b/instafire-de474.appspot.com/o/images%2FgoldenGate.jpg?alt=media&token=bcf178a5-3392-4d38-ba5b-4bac9534d371"

user

age: 24

username: "nathan"



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mwu46qOOTpnuqfhit3MG

t55wS4P4sn3rgQizlNxg

tSE4LIXVIkzKswiUSdGd

vX8qTOLyl6CBtWBg9F7s

LeRGBGreNJ6EF42wqqYw

creation_time_ms: 1584174995435

description: "My hipster look"

image_url: "https://firebasestorage.googleapis.com/v0/b/instafire-de474.appspot.com/o/images%2Fhipster.jpg?alt=media&token=057e03cd-99d8-4a20-9532-7d4c90d4d3fb"

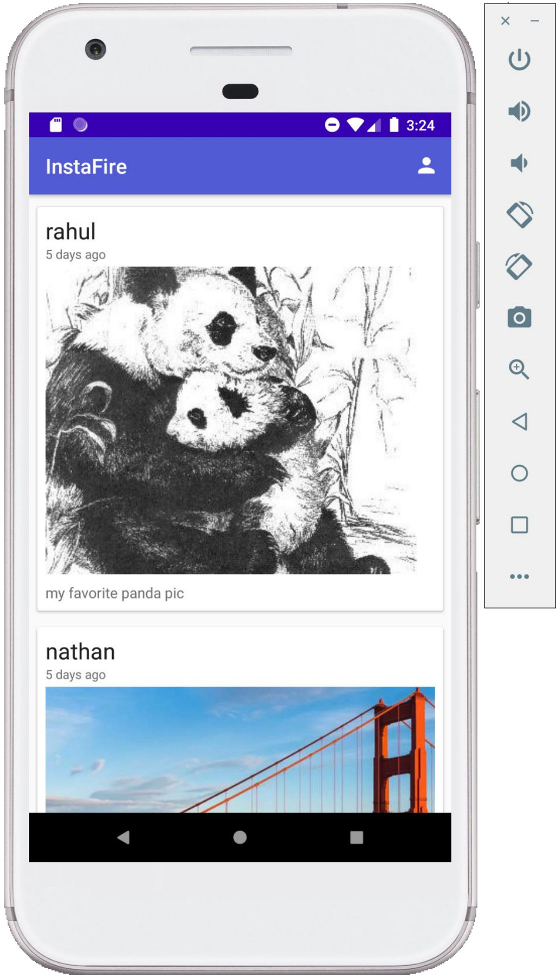
user

age: 52

is_celebrity: false

username: "rahul"

Optional: Go through the Instagram clone using Firebase



rahul
5 days ago
my favorite panda pic

nathan
5 days ago

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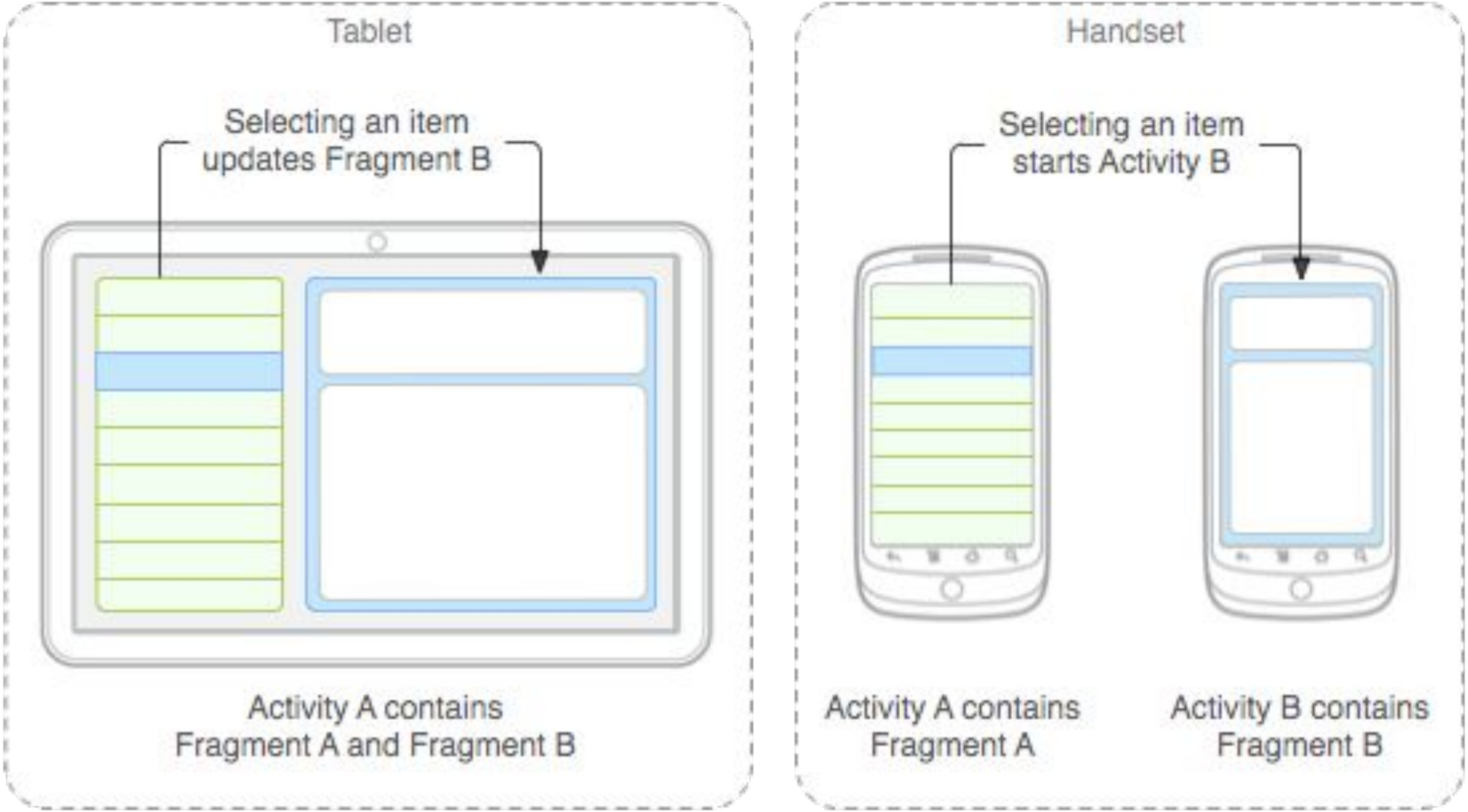
- Alternatives to native app development

Fragments

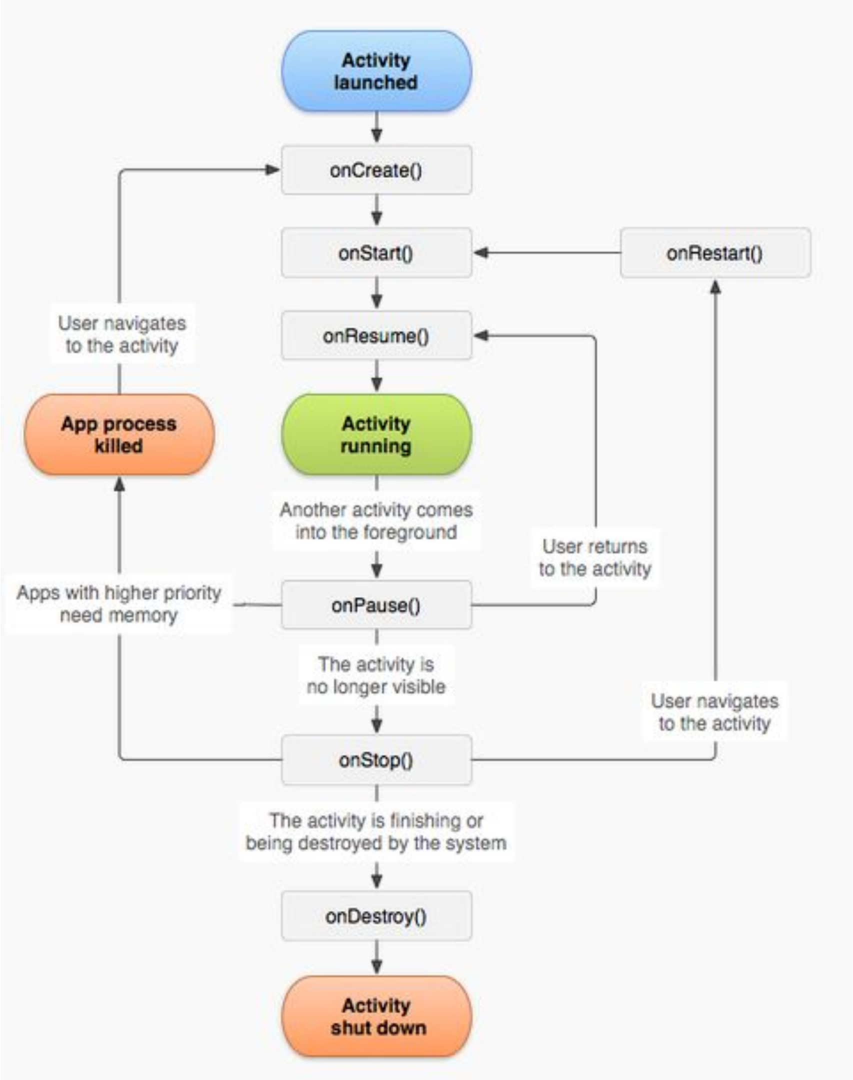
- A reusable portion of UI that lives inside an Activity.
- Multiple fragments can be combined in one activity
  - Helps to handle different devices and screen sizes
  - Helps to reuse common UI across your app
- Has its own lifecycle similar to the Activity lifecycle


Tablet
Selecting an item updates Fragment B
Activity A contains Fragment A and Fragment B
Handset
Selecting an item starts Activity B
Activity A contains Fragment A
Activity B contains Fragment B

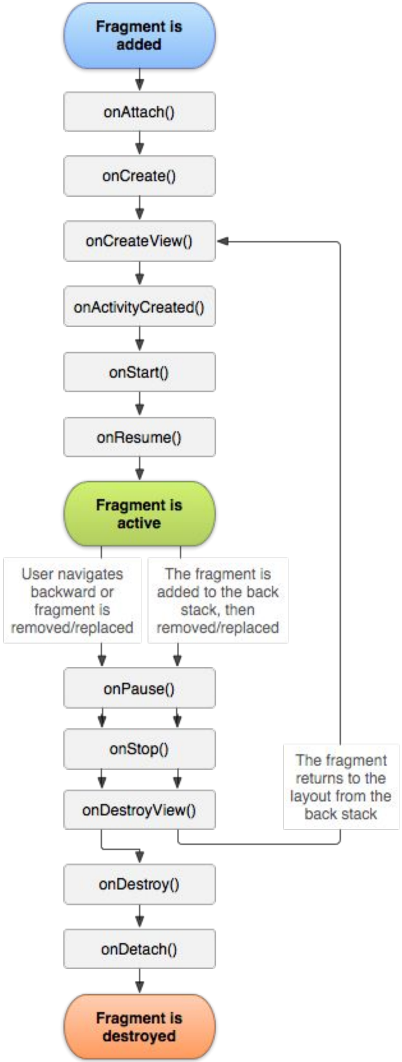
Fragment vs Activity

- Methods defined on the activity are not available in the fragment
    - Need to use the activity property to access the enclosing activity
- Passing/accessing information in a fragment (intents/bundles) is done by asking the enclosing activity
- Fragment initialization and lifecycle are different
    - Activity: `onCreate`
    - Fragment: `onActivityCreated`

Activity lifecycle


Activity launched
onCreate()
onStart()
onRestart()
User navigates to the activity
onResume()
App process killed
Activity running
Another activity comes into the foreground
User returns to the activity
Apps with higher priority need memory
onPause()
The activity is no longer visible
User navigates to the activity
onStop()
The activity is finishing or being destroyed by the system
onDestroy()
Activity shut down

Fragment lifecycle



Fragment is added

onAttach()

onCreate()

onCreateView()

onActivityCreated()

onStart()

onResume()

Fragment is active

User navigates backward or fragment is removed/replaced

The fragment is added to the back stack, then removed/replaced

onPause()

onStop()

onDestroyView()

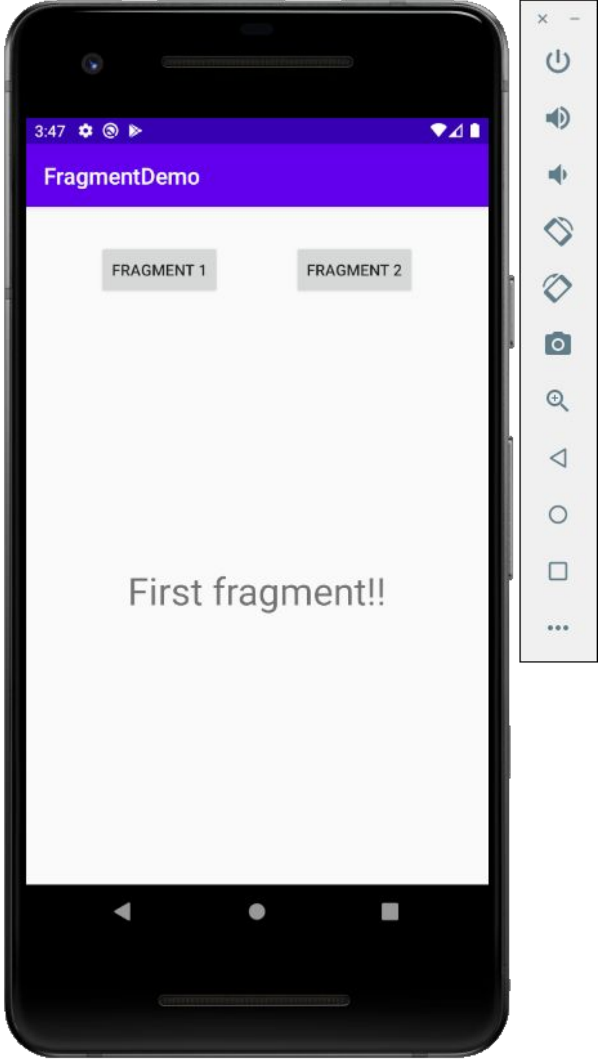
The fragment returns to the layout from the back stack

onDestroy()

onDetach()

Fragment is destroyed

Code pointer



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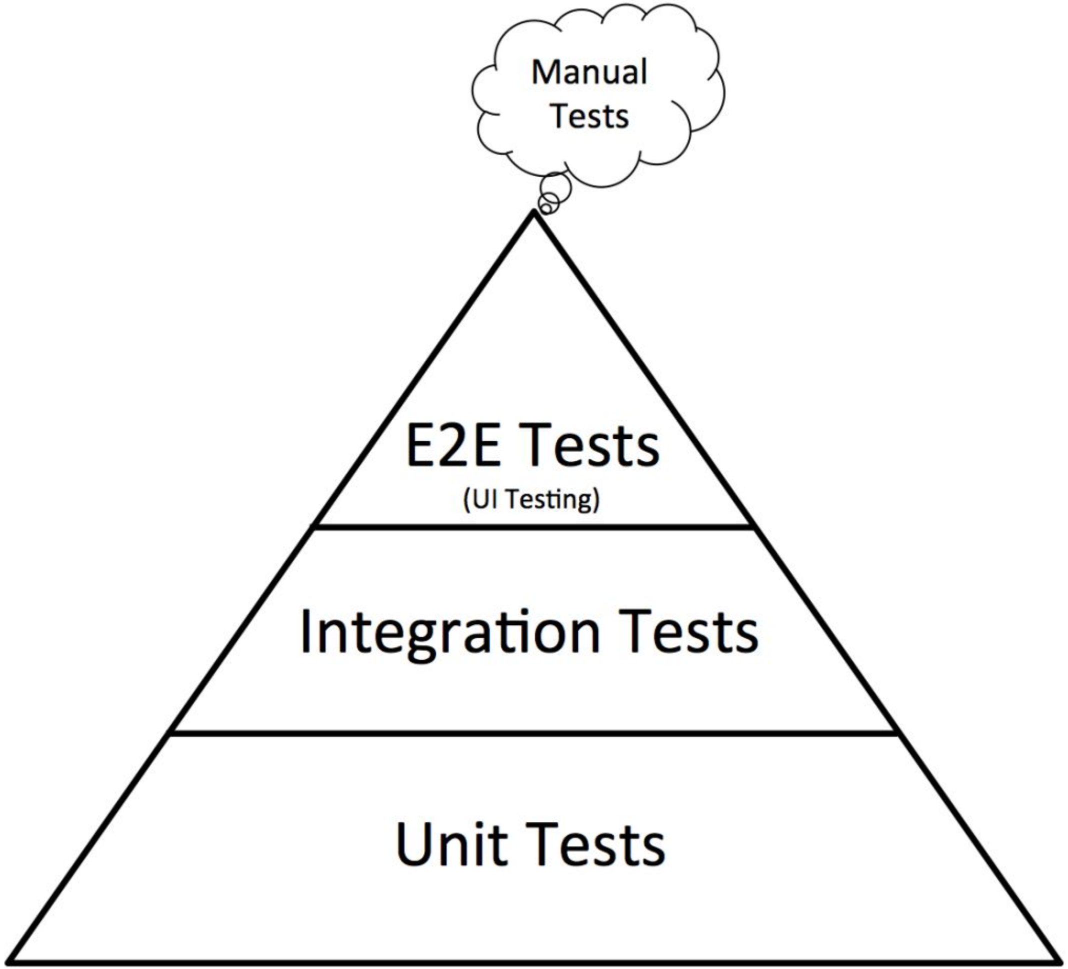
Manual Tests
E2E Tests
(UI Testing)
Integration Tests
Unit Tests

Source

Android testing

Why is it hard?

- **End to end testing**: directly testing the UI is flaky, e.g. dropdown takes time to render
  - Espresso: requires an emulator
- **Integration testing**: check interaction between different components
  - Robolectric: mock Android components
- **Unit testing**: just one component, no interaction with Android framework
  - JUnit/Mockito: very fast to run

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App architecture

- Architecture: “fundamental structures of a software system”
- Architecture educates how you organize your code
    - Has consequences around how easy it is to debug your code or onboard new devs
- Different components of all mobile apps:
    - UI or view layer
    - Data classes or models
    - Repository: holds or retrieves the data
    - “Business logic” component for responding to user input

Android app architectures

- **Objective**: avoid having all logic live inside Activities

- **MVC**: Model View Controller
- **MVP**: Model View Presenter
- **MVVM**: Model View ViewModel

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Alternatives to native app development

What problem are they trying to solve?

1. Double the effort to ship an app two platforms (Android + iOS)
2. Developer experience sucks- gatekeepers to releasing your code

React Native

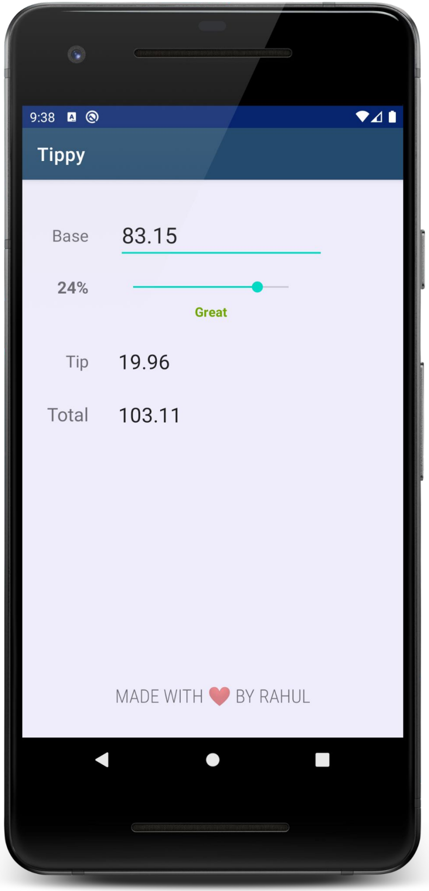
- Developed by Facebook for cross platform app development (move faster)
- Uses JavaScript, source code is converted to native elements
- Tight platform integration, ability to write modules in platform code
- Heavily used across industry: Facebook, Uber, Walmart

Flutter

- Created by Google
- UI toolkit for building native apps for mobile, web, and desktop in a single codebase
- Provides a full native experience by using native compilers
- Uses the Dart programming language
- Less mature than React Native but growing

Xamarin

- Bought by Microsoft
- Uses .NET and C# (Microsoft technologies)
- Also turns into native code
- 75% code sharing between platforms
- Not as popular in Silicon Valley, but has a mature community



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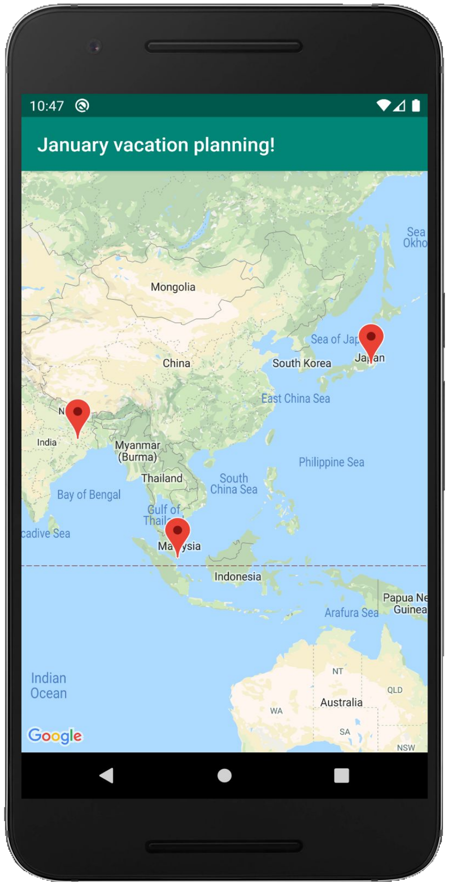

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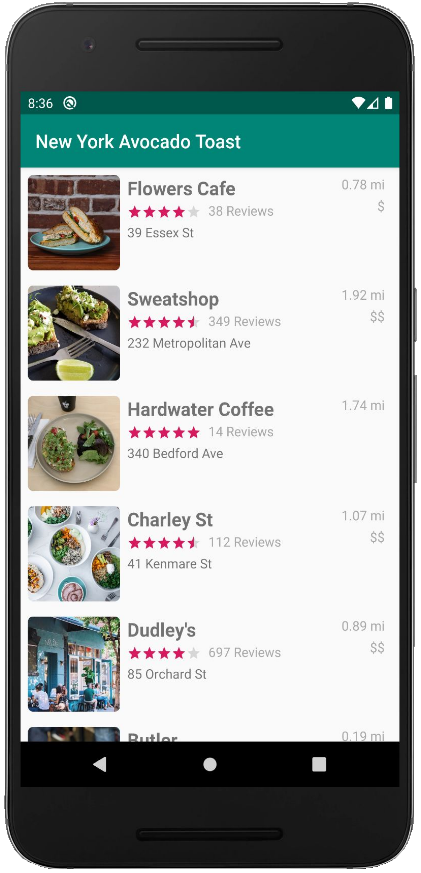

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